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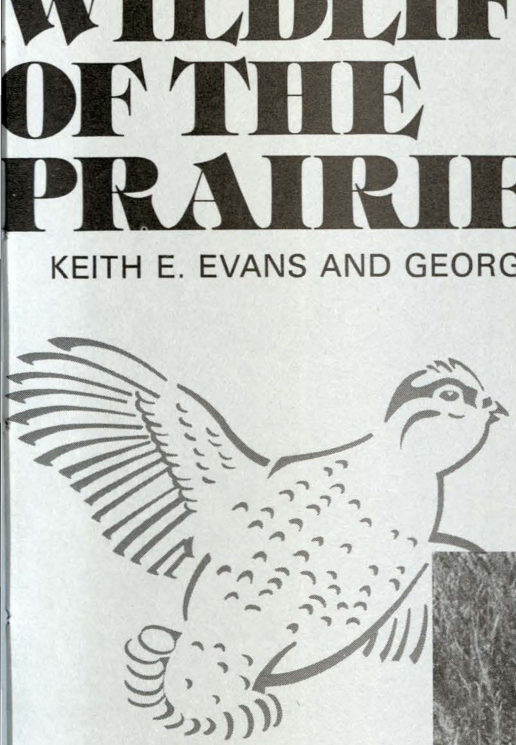
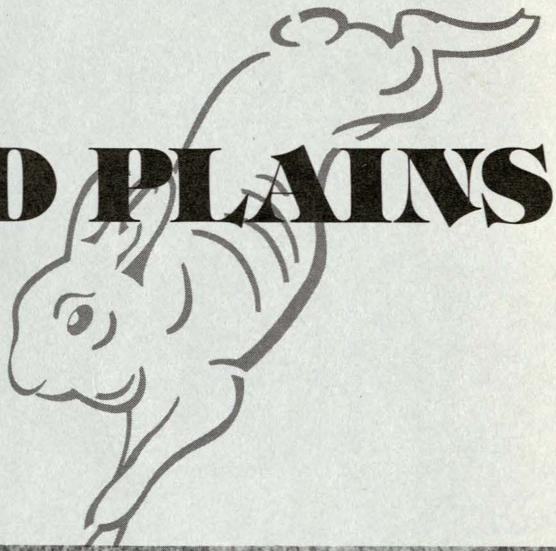
WILDLIFE OF THE PRAIRIES AND PLAINS

KEITH E. EVANS AND GEORGE E. PROBASCO





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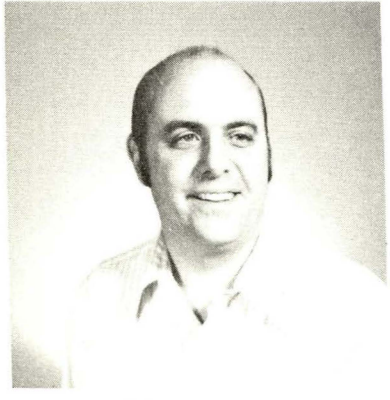

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WILDLIFE OF THE PRAIRIES AND PLAINS

Keith E. Evans and George E. Probasco

The extensive and diverse grasslands of North America were maintained and perpetuated under the land use policies of the aborigines. Grasses dominated the low rainfall Great Plains for many thousands of years and still do except where cultivation or destructive grazing have occurred. Fire was required in the higher rainfall prairie and savannah areas to control woody plant encroachment. Some of the wildlife species adapted to these grasslands included bison, antelope, elk, bear, rabbits, prairie dogs, wolves, coyotes, and grouse. The river bottoms and badlands in the area provided habitat for deer, Audubon's bighorn sheep, bobcat, mountain lion, turkey, quail, and waterfowl.

In the late 1800's the American frontier expanded westward--the day of the true "wild west". Settlement under the Homestead Act of 1862 encouraged many people to settle on the prairies and plains. In a short span of time the area changed from wild grasslands teeming with wildlife to civilized areas of farms, ranches, fences, towns, roads, and railroads. The 19th century witnessed the beginning and end of the Oregon Trail, gold rushes, open range, and cattle drives.

The wet years and high prices associated with World War I made the Great Plains look like the promised land to many farmers. However, the years of productivity and profits gained by cultivating low rainfall areas were short. First came low postwar prices, then high taxes, low rainfall, and dust. Thus began the "dust bowl" days of the 1930's.

For the most part, the economy and land use patterns on the North American grasslands have again become fairly stable. A large proportion of the original grasslands are now being cultivated. The tall grass prairie once covered 42 million acres, but now has been reduced to 18 million acres. Over much of the remaining uncultivated tall grass prairie region, livestock overgrazing has altered the plant and animal composition drastically. Extensive areas are managed for livestock production by perpetuating the native flora. These areas are inhabited by many wildlife species.

THE RESOURCE

Grasslands encompass the most extensive and varied of all plant communities in North America (fig. 1). The midcontinent grassland extends 2,500 miles north to south and averages 400 miles in width from the Rocky Mountains east as far as Illinois. It includes four of the eight major grassland types recognized in North America: (1) oak-bluestem savannah, (2) tall grass, (3) mixed grass, and (4) short grass. The remaining four are: (5) bunch grass, such as the palouse prairie in Oregon, Idaho, and Washington, (6) annual grass in the California's Central Valley, (7) desert grassland in New Mexico and Arizona, and (8) the coastal prairies in Texas, Louisiana, Maryland, New Jersey, New York, Rhode Island, and Massachusetts.

The oak-bluestem savannah stretches from southeast North Dakota and middlewest Minnesota south along the eastern edge of the tall grass prairie to mideastern Texas. It is actually the transition zone or ecotone between the eastern deciduous forest and the tall grass prairie. Scattered segments of savannah occur throughout the oak-hickory forest and the eastern part of the bluestem prairie. The bluestem-oak-hickory forest mosaic, cedar glades, and cross timber vegetation types of Kuchler's (1964) Potential Natural Vegetation Map are included as savannah. The greater part of the Ozark Dome is often included as part of the savannah (Marbut 1911, Davis 1964).

The tall grass prairie formerly occupied the ecotone between the savannah and the mixed grass prairie. Fire was an important factor in preventing the forest type from invading the prairie (Curtis

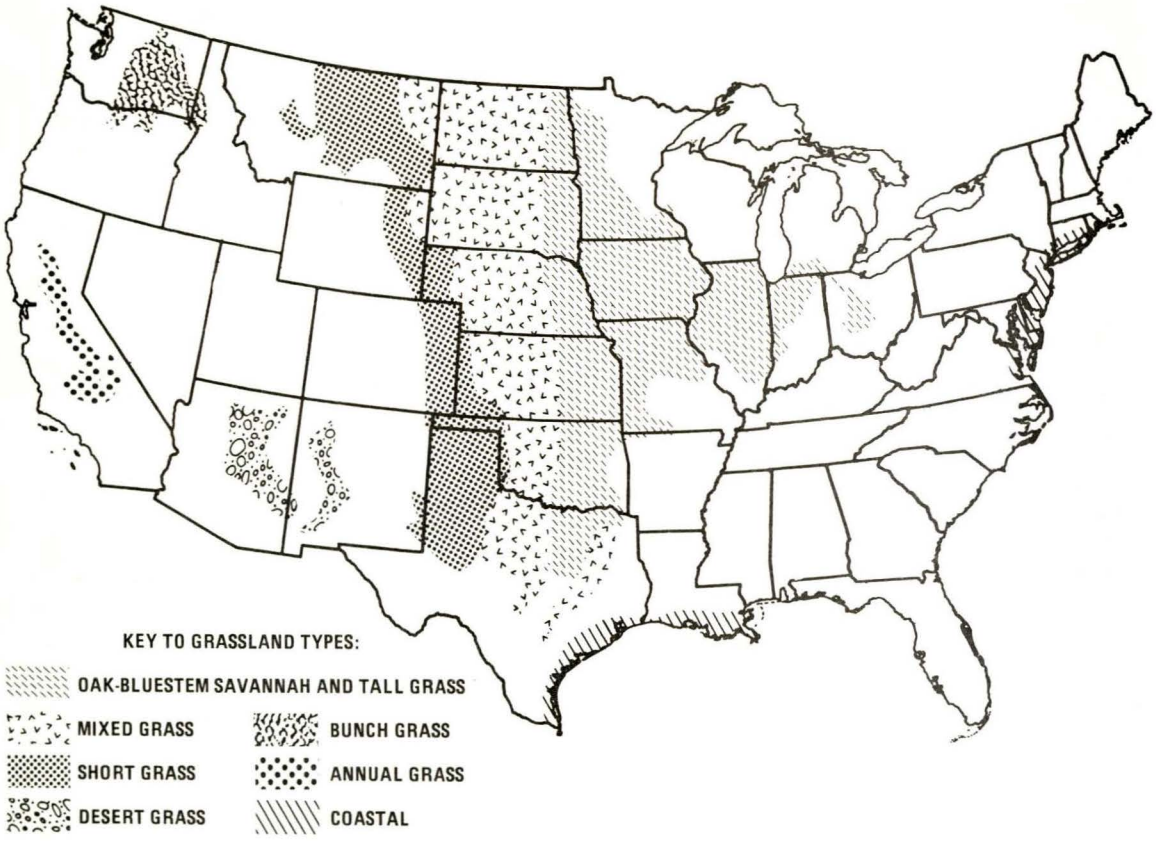

Figure 1.--*Principal grassland types of the United States.*

1959). Currently most of the tall grass prairie has been converted to forest, to mixed grass, or plowed. The conversion to mixed grass resulted from prolonged extensive livestock grazing.

The mixed grass or needlegrass-wheatgrass-grama grass (*Stipa-Agropyron-Bouteloua*) community occupies the area west of the tall grass region, nearly to the foothills of the Rocky Mountains. There is no definite line between the mixed grass and short grass (*Bouteloua-Buchloe*) vegetation types. The thin soil and low precipitation areas are dominated by the short grass species whereas the northern and eastern Great Plains areas contain a vegetation type dominated by the mixed grass species.

General aspects of the other grassland types are discussed in subsequent sections of this paper.

Terrain, Soil, and Climate

The topography of the midcontinent grasslands is variable, but generally it is moderately rolling. Some areas, such as the Red River Valley, are virtually flat; other areas (river breaks) along the major drainages are steep. Major soil groups include Alfisols, Mollisols, Vertisols, Inceptisols, and Aridisols. There is a gradient from the cool, moist soils in the northeast to the warm, dry soils in the southwest.

Climate of the midcontinent grasslands is temperate and subject to extreme fluctuations. Summers in the north are hot and winters are cold while in the south winters are less severe. Temperatures range from -40 C to +40 C in the north and from -10 C to +40 C in the south (Kincer 1941). The frost-free season ranges from less than 4 months in the north to nearly the entire year in southern Texas.

When periodic droughts occur, the precipitation failure usually occurs in July and August. During these droughts rainfall will vary from 50 to 90 percent of normal (Borchert 1950). Average annual precipitation varies from 115 cm in the savannah to 65-80 cm in the tall grass prairie, to 50 cm in the mixed grass prairie, and to less than 35 cm in parts of the short grass prairie. Evaporation is a significant factor in midcontinent grassland climate. Except in the savannah and tall grass prairie, the evaporation potential exceeds precipitation. Strong winds prevail over the grasslands inducing high evaporation rates and exerting considerable influence on the thermoregulatory behavior of homeothermic wildlife. Winds often become more intense during drought periods (Borchert 1950).

The other grassland areas have different climates. The coastal prairies are wet, humid, and generally mild, and not subject to the temperature extremes of the intercontinental areas. Annual precipitation for the coastal prairies ranges from 100 to 140 cm. Average annual temperatures in the northern areas range from a low of 0 C to a high of 25 C, while in the southern areas temperatures range from 13 C to 30 C. The bunch grass (palouse) prairie receives most of its moisture in the form of winter snow. The California Central Valley and desert grasslands usually receive winter rain with hot, dry summers. Annual precipitation in these grasslands is generally 50 cm or less. Average annual temperatures in the bunch grass prairie range from -5 C to 25 C. In the latter two grassland areas the temperature range is 5 C to 27 C (Kincer 1941).

Vegetation

Weaver (1954) summarized the impacts of drought and Daubenmire (1968) of fire on grasslands. Under extended drought conditions, the grass cover is reduced and the plant species composition altered (Albertson *et al.* 1957, Coupland 1958).

Fire, which frequently accompanies the drought, makes additional demands upon the vegetation. Some woody plants such as black oak (*Quercus velutina*), eastern redcedar (*Juniperus virginiana*), and ashe's juniper (*Juniperus ashei*) are particularly vulnerable to fire.

Native Americans and early settlers utilized fire to attract and hold game and to prepare the range for early spring grazing. Fire suppression efforts early in this century effectively reduced the use of fire for these purposes. However, research in the Kansas Flint Hills (Anderson *et al.* 1970), Missouri (Kucera and Koelling 1964), and Texas (Wright 1974a, 1974b) reveal that obligate relations may exist between fire and some grassland plants.

Drought, fire, cultivation, and grazing all influence vegetation composition. The influence of the vast herds of bison is probably the least understood influence. For example, there is disagreement as to the successional status of the short grass plains. Many, including Shelford (1963), distinguish the short grass type as a distinctive unit (climax vegetation type). Weaver and Albertson (1956) refer to the short grass as a disclimax reflecting past grazing use. Larson (1940) offered the following evidence to support the view that the short grass plains represent the true climax of the pristine biome:

1. Historical records indicate the large herbivores stocked the plains to carrying capacity and the introduction of livestock was merely a substitution for grazing by wildlife.

2. Explorers and pioneers referred to the short grass plains long before livestock was introduced.

3. The marked ability of the short grass dominants to withstand grazing, indicating they evolved with grazing as an environmental factor.

Regardless, bison stocking rates probably varied from extremely heavy use to no use because fences were not present to restrict bison grazing. Moreover, the grasslands in presettlement times probably were subjected to frequent and erratic periods free of grazing during which changes in vegetation occurred because of climatic or moisture conditions.

Overgrazing by bison, however, probably did encourage the growth of short grass species and produced conditions favoring the "invasion" of some annual or biennial species.

The former tall grass, oak-bluestem savannah, and mixed grass types today make up one of the most productive crop-growing regions in the world: the first two combined are known as the "Corn Belt"; the third, the "Wheatland". The vegetation of those portions of these areas still remaining in grass has often been altered because cool season species have been planted to replace native warm season grasses.

A vegetation gradient, corresponding to the soils gradient, occurs across the midcontinent grasslands from east to west and from north to south. Ecologists divide the area into several vegetation types, however, the ecotones or transition zones between types are wide, variable, and depend on past land use and climatic conditions. Much of the region is actually a mosaic of several types. A wide diversity of plants occur on the grasslands. The following discussion is limited to a few of the dominant species.

Big bluestem (*Andropogon gerardi*)[1] is the dominant component in the oak savannah and tall grass prairie. Big bluestem also occurs on better sites throughout the mixed grass prairie. Sand bluestem (*A. hallii*), a close relative of big bluestem, occurs on sandy soils in the tall, mixed, and short grass prairie. Little bluestem (*A. scoparius*) dominates the drier, upland portions of the savannah and extends its range westward to become an important dominant throughout the mixed grass prairie. Little bluestem is a warm season bunch grass that commonly provides excellent cover for many wildlife species. There are many more species of *Andropogons*, but the only other one noted here is broomsedge (*A. virginicus*), which commonly occurs on old fields and overgrazed pastures in the east.

Other warm season grasses associated with the tall grass prairie include switchgrass (*Panicum virgatum*) and Indian grass (*Sorghastrum nutans*). Prairie cordgrass (*Spartina pectinata*) occurs around the prairie marshes and along the drainage systems throughout the tall and mixed grass prairie. Warm season grasses also dominate the short grass areas. Blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) occur on the dry and abused sites throughout the mixed grass area and dominate the short grass plains.

The mixed grass prairie contains components of the tall grass prairie on the better sites and species from the short grass plains on the thin soil or dry sites or where abusive grazing has been practiced. There also are a number of grass species that reach heights of 60 to 90 cm and fill the niche between the tall grasses (often over 2 m), and the short grass (less than 20 cm). These include western wheatgrass (*Agropyron smithii*), side-oats grama (*Bouteloua curtipendula*), several species of needlegrass (*Stipa* spp.), Junegrass (*Koeleria cristata*), and several species of dropseeds (*Sporobolus* spp.). Cool season grasses play an important role throughout the mixed grass prairie and are dominant on the northern Great Plains.

Herbaceous broadleafed plants (forbs) increase the range forage value and provide esthetical values to photographers and other rangeland recreationists. The composite family (Compositae) and the legume family (Leguminosae) are well represented. Common composites include sunflowers (*Helianthus* spp.),[2] rosinweeds (*Silphium* spp.), and coneflowers (*Ratibida* spp., *Rudbeckia* spp., and *Echinacea* spp.). Common legumes include leadplant (*Amorpha* spp.), false indigos (*Baptisia* spp.), prairie clovers (*Petalostemum* spp.), and *Psoralea* spp.

Common shrubs and trees occurring on the savannah and tall grass prairie include: smooth sumac (*Rhus glabra*), snowberry (*Symphoricarpos* spp.), dogwood (*Cornus* spp.), hawthorn (*Crataegus* spp.), plum (*Prunus* spp.), hazelnut (*Corylus americana*), oak (*Quercus* spp.), elm (*Ulmus* spp.), and eastern redcedar (*Juniperus virginiana*) (Aikman 1929, Bruner 1931, Curtis 1959, Kucera 1960, Weaver 1954).

Periodic droughts restrict woody plant invasion on the mixed and short grass plains to the moist areas along drainages. These woodlands provide cover, food, and landscape diversity for many wildlife species. Dominant trees include: ash (*Fraxinus* spp.), cottonwood (*Populus* spp.), willow (*Salix* spp.), elm (*Ulmus* spp.), and boxelder (*Acer negundo*). Many shrub species occupy the understory.

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[1] *Nomenclature for grasses follows Hitchcock (1950).*

[2] *Nomenclature for forbs, shrubs, and trees from Harrington (1954).*

The palouse region and California Valley were originally dominated by bunch grass species, such as bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*). The palouse prairie is now mostly under cultivation and the California Valley has been converted to an annual grassland containing many introduced species including chess (*Bromus* spp.). The desert grasslands are dominated by curly mesquite (*Hilaria belangeri*), galleta (*Hilaria jamesii*), and grama (*Bouteloua* spp.). The coastal prairies contain mostly tall grass species such as bluestem (*Andropogon* spp.) and cordgrass (*Spartina* spp.).

Wildlife Species

Waterfowl

The destruction of waterfowl habitat lagged behind the destruction of most of the prairie by the plow because it was easier to plow the dry uplands than to drain the wetlands. Only a few years later, with the development of large equipment (early 1900's) and govermental assistance programs (1930's), large-scale drainage programs were initiated. By the 1950's, these had reduced the original wetlands in the United States from 127 million acres to 82 million acres (Linduska 1964).

Prairie potholes are the backbone of duck production in North America. The prairie potholes region, 300,000 square miles, makes up only 10 percent of the total waterfowl breeding area of this continent, yet produces 50 percent of the duck crop in an average year--more during good years (Linduska 1964).

With a few wet years the prairie potholes provide habitat for a rapidly expanding waterfowl population. Several successive drought years bring an inevitable crash. Although droughts cause short-term declines in duck numbers, they help to maintain fertility and increase pond life. These long-term advantages probably far outweight the short-term disadvantages.

Fifteen species of ducks nest commonly in the prairie pothole region. Most abundant are the mallard (*Anas platyrhynchos*),[3] pintail (*Anas acuta*), and blue-winged teal (*Anas discors*). Other species include shovelers (*Spatula clypeata*) and gadwalls (*Anas strepera*), which seek the grasslands; green-winged teal (*Anas carolinensis*), lesser scaup (*Aythya affinis*), bufflehead (*Bucephala albeola*), ring-necked ducks (*Aythya collaris*), common goldeneyes (*Bucephala clangula*), and white-winged scoters (*Melanitta deglandi*), which are more abundant in the semiforested park lands; and redheads (*Aythya americana*), canvasbacks (*Aythya valisineria*), and ruddy ducks (*Oxyura jamaicensis*), which seem content with either a park land or a prairie habitat (Linduska 1964).

Over most of the northern unglaciated mixed grass plains, natural ponds were scarce under pristine conditions. Since the early 1930's more than 300,000 stock ponds have been constructed in North and South Dakota, Minnesota, and Montana and 10,000 have been constructed on the prairie provinces of Canada. These ponds produce about 1,000,000 waterfowl each year (Linduska 1964). Duck breeding population estimates vary between 3.3 pairs per square mile (1.8 pairs per surface acre of water), according to Lokemoen (1973) and 7.0 pairs per square mile (2.3 pairs per surface acre of water), according to Bue *et al.* (1952). Broods averaged from 0.79 per acre of stock-watering pond (Lokemoen 1973) to 1.5 broods per acre of pond (Bue *et al.* 1952).

During recent years, populations of the Canada goose (*Branta canadensis*), such as those wintering on the short grass plains, have steadily increased because prairie lands have been cultivated and bodies of water impounded. Irrigation using water from these impoundments and from wells has provided large acreages of wheat, milo, and corn that offer more and better foods than do native grasses (Grieb 1970).

Upland Game Birds

Before settlement, greater prairie chickens (*Tympanuchus cupido*) were confined primarily to the tall grass prairie. Their range gradually extended westward as the native sod gave way to farms and wheat fields throughout the mixed grass prairie types (Cooke 1909). Prairie chicken populations thrived with white-man's first attempt at farming. This was attributed to the abundance of food and undisturbed nesting areas ("prairie-type" land intermingled with patch farming). With patch

[3] *Avian nomenclature follows American Ornithologists' Union (1957).*

farming operations, prairie chicken populations peaked in Iowa about 1880 when 69 percent of the State was cultivated. By 1900, 90 percent of Iowa was cultivated and prairie chicken numbers were decreasing (Stempel and Rodgers 1961).

Prairie chickens were first recorded in North Dakota in the early 1880's (Johnson 1964) and in Colorado in 1897 (Sclater 1912). Their populations increased and flourished during the "good pinnate years" between 1900 and 1930. With the dust bowl days of the 1930's small ranches and farms were abandoned or incorporated into larger holdings. This led to large areas of intensive cultivation on the better soils and grasslands only where the soils were too sandy or the land too hilly to farm. With very little winter food on the grasslands and virtually no nesting cover on the farmlands, prairie chicken numbers decreased drastically. Prairie chicken numbers followed this same pattern over most of the Great Plains (Beck 1957, Evans and Gilbert 1963, Johnson 1964).

The lesser prairie chicken (*Tympanuchus pallidicinctus*) inhabits a small area of grassland and brushland located in northern Texas, western Oklahoma, southwestern Kansas, southeastern Colorado, and eastern New Mexico. Their populations are fairly stable. Habitat of the Attwater's prairie chicken (*Tympanuchus cupido attwateri*) is disappearing along the Texas Gulf Coast; consequently, this bird is currently listed as an endangered species. The heath hen (*Tympanuchus cupido cupido*), which formerly occupied the coastal prairies of the New England States, is now extinct.

Since pioneering days the sharp-tailed grouse (*Pedioecetes phasianellus*) has been a part of the animal life on the brushlands, park lands, savannahs, and plains of much of the northern United States and southern Canada (fig. 2). Johnson (1964) stated that sharptails probably have been in North Dakota for hundreds of years. As with the prairie chicken, sharptail numbers decreased during the drought of the 1930's, and never regained their previous high. Intensive cultivation and certain grazing practices have decreased sharptail range and populations numbers throughout most Great Plains States.

Habitats of the sharp-tailed grouse include (Aldrich 1963):

Figure 2.--*Sharp-tailed grouse have been and still are the prominant upland game bird of the northern brushlands, park lands, and plains.*

1. The climax sagebrush of the northern desert shrub area (Columbian sharp-tailed grouse).

2. The subclimax brush in the grasslands east of the Rocky Mountains and in the park lands of the Rockies (plains sharptail).

3. The oak-savannah and logged or burned areas in the east (prairie sharptail).

4. Openings in the boreal forest (northern sharptail, Alaskan sharptail, other boreal forest races).

The bobwhite quail (*Colinus virginianus*) is a savannah species, with its populations most stable in the southern two-thirds of the savannah area (Rosene 1969, Johnsgard 1973). In the northern third of the savannah, populations decrease during years of adverse climatic conditions. The bobwhite has adapted to the habitats associated with agriculture; consequently, it is abundant even in extensively cultivated areas.

The wild turkey (*Meleagris gallopavo*) is considered a forest bird; however, archeological evidence indicates that Indians in the savannah utilized the turkey for both food and ornamentation. Shortly after 1900, exploitation and habitat destruction resulted in the extirpation or near extirpation of the turkey in the savannah (Hewitt 1967). Today, as a result of State restocking programs, turkeys are found throughout all their former range as well as in areas that originally did not support wild turkeys (Sanderson and Schultz 1973). Good turkey range contains trees for roosting and trees that produce mast and fruit for food. The grasses and forbs of the understory produce seeds and habitat for insects upon which young turkeys feed. Occasionally turkeys will feed on cultivated crops. Turkeys are found in the savannah as well as along the wooded stream and river drainages throughout the mixed grass prairie.

The mourning dove (*Zenaida macroura*) (American Ornithologists' Union 1973) is primarily migratory and depends on the northern prairies and savannahs for life requirements only during the breeding season. Populations do winter in the southern grassland types, depending on food availability. Preferred habitat for the mourning dove consists of tree cover for nesting and fields with open cover for feeding. Hedgerows, shelterbelts, orchards, or woodlots provide acceptable nesting habitat (Hanson and Kossack 1963). When conifers are available, doves prefer them for nesting (Hanson and Kossack 1963, Caldwell 1964). The weak feet and bill of the mourning dove limits its feeding activities to areas of sparse cover. Harvested fields, field margins, and overgrazed pastures contain the waste grains (wheat and corn) and weeds (foxtail) preferred by the dove (Korschgen 1958, Hanson and Kossack 1963, Ward 1964).

Nongame Birds

Predatory birds have suffered because of man's ignorance and apathy. Overzealous control programs and pesticide use have seriously reduced some species populations and caused others to be placed on the endangered and threatened species list. As one becomes knowledgeable of the feeding habits of these birds, it is evident that they, too, are important components in the biotic communities to which they belong.

Birds of prey occurring in grasslands include the red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), rough-legged hawk (*B. lagopus*), sharp-shinned hawk (*Accipiter striatus*), and American kestrel (*Falco sparverius*). The large hawks feed on rabbits, small mammals, and snakes, the small hawks and falcons on small mammals and birds, snakes, and insects. In addition to their importance in food chains, these birds contribute to man's pest control efforts. The nocturnal raptors include the great horned owl (*Bubo virginianus*), short-eared owl (*Asio flammeus*), long-eared owl (*Asio otus*), and burrowing owl (*Speotyto cunicularia*). Many other avian species occur on the grasslands. Their role and function in grassland ecosystems is discussed in Wiens and Dyer (1975).

Bison

The American bison (*Bison bison*)[4] was the one feature of the North American central grasslands that all historians, naturalists, trappers, or travelers mentioned in the diaries concerning the pristine conditions of the area (fig. 3). Based on a series of assumptions about carrying capacity, range area, habits, and population trends, Seton (1929) estimated a population of from 40 to 60 million bison in North America. Bison were once spread over one-third of the North American Continent with the largest herds distributed along the Mississippi River Valley. During the years previous to disturbance by white man, the total area inhabited by bison was about 3 million square miles (Seton 1929).

Overgrazing by bison, in association with trampling, rubbing, and wallowing, contributed to the creation and maintenance of environmental conditions favorable to a variety of other wildlife (England and Devos 1969). Bison are primarily grazers, so they depended on the herbaceous vegetation for food. Few herbivores possessed the capability for altering the environment as did the bison. These animals require approximately 30 pounds of forage per day, so even large areas could easily be overgrazed.

A dramatic change occurred on the Great Plains during the 1800's. Prior to

[4] *Mammalian nomenclature from Hall (1965).*

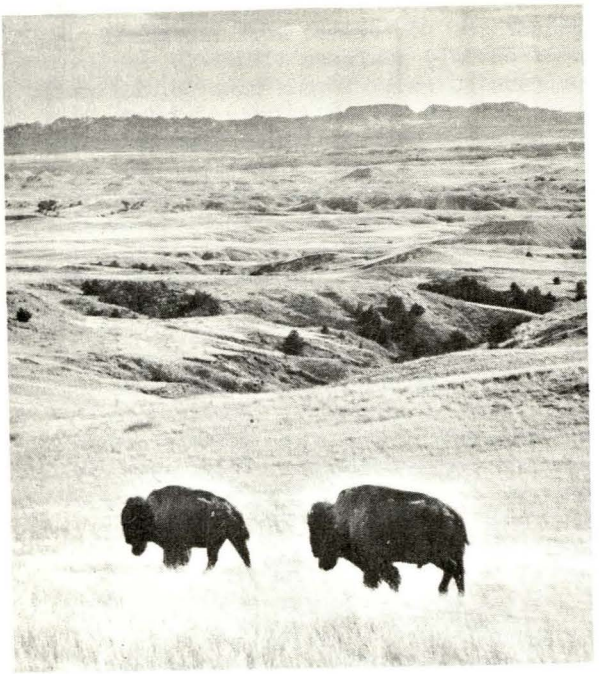

Figure 3.--*The bison or American buffalo was once the dominant animal on the North American central grasslands.*

this time the Indians were completely dependent on bison for their livelihood. Their hunting methods did not cause major changes in bison numbers, and usually resulted in a harvest of surplus animals. It is estimated that approximately 300,000 plains Indians existed primarily by hunting the bison herds between Mexico and Lake Winnipeg and from the Rocky Mountains to the Mississippi River (Allen 1954). The part-Arab horses, escaping from the Spaniards, gave the Indian additional hunting ability. Even with the horse and bow the Indian could not seriously deplete his resource, as the gun and fence was to do later. Liquidation of the bison took about 50 years--by 1883 only a few animals remained.

Pronghorn Antelope

Before intensive settlement of the United States, pronghorn antelope (*Antilocapra americana*) (fig. 4) were the codominant grazing species with bison on the Great Plains and with elk on the Palouse and California Prairies. They were as numerous, if not more so, than the bison (Rand 1945). The present range of pronghorns is more restricted (England and Devos 1969). Most historical writings

Figure 4.--*The present day land-use patterns provide habitat for extensive herds of pronghorn antelope.*

don't refer to excessive slaughter of antelope. Therefore, if antelope were as numerous as estimated, and if they were not slaughtered to the same extent as bison, why did population numbers decrease so greatly?

Perhaps it was due to the reduction in suitable habitat brought about by the extermination of bison and the extensive construction of fences. Perhaps their decline can be attributed to a high susceptibility to disease. Traveling from Fort Abraham Lincoln west to the Little Missouri in 1873, J. A. Allen reported that he saw antelope almost constantly (Bailey 1926). In the interim before his return trip a few months later, a fatal epizootic raged among the pronghorns over most of the area between the Yellowstone and Missouri Rivers and 75 to 90 percent of the pronghorns perished.

Pronghorn antelope populations decreased from an estimated 40 million (Seton 1929) to 13,000 around 1915 (Hoover *et al.* 1959). The species was then afforded rigid protection by landowners and law enforcement agencies, and their current population is estimated at 365,000 (Yoakum 1968). The increase is attributed to: (1) controlled hunting, (2) favorable habitat, and (3) improved wildlife management practices such as transplanting programs, water developments, and fences constructed to permit pronghorn travel.

Pronghorns fill a forage utilization niche that is between the grazers (bison and elk) and the browsers (deer). Pronghorn antelope have adapted well to changes in prairie vegetation resulting from livestock grazing.

When populations of pronghorns and livestock are in adjustment with the forage capacity of a good condition range, competition between cattle and pronghorns is negligible. The compatability of cattle and pronghorn antelope is similar to that which must have existed, in the past, between bison and pronghorn. Competition between domestic sheep and pronghorns can be so severe that the latter will be eliminated. Sheep, which can be kept alive with supplemental feeding, can overgraze the vegetation to a point where it is unable to support pronghorn antelope (Buechner 1960).

Elk

The pristine range of the elk, or wapiti, was as widespread in North America as that of the bison. At least two species of elk inhabited the grasslands and wooded river bottoms: Nelson's elk or wapiti (*Cervus canadensis*), which inhabited the midcontinent grasslands, and the northern Pacific coast grasslands, and the Tule elk (*C. nannodes*), which occupied the Southern Pacific area in the Central Valley of California (McCullough 1969).

The carrying capacity of the Tule elk was estimated at 500,000 animals in pristine time. Several factors contributed to the decline and near extinction of the Tule elk. First, the Spanish settlements of the late 1700's and the invasion of the annual grasses which resulted in the displacement of the dominant bunch grasses, which no doubt had adverse effects upon the Tule elk population (McCullough 1969). Then the increase in competition by wild cattle and horses, the gold rush (1848), and the resulting slaughter of wild animals during the booming market-hunting years, further decimated the population. By 1855, the market-hunting era brought the Tule elk to the end of its time as an important element in the fauna of the region. Today there are about 400 to 500 Tule elk in California's Central Valley (McCullough 1969). The wapiti or Nelson's elk have been completely eliminated over the rest of the grassland habitats they formerly occupied. Their populations are now limited to high mountain ranges.

Deer

The white-tailed deer (*Dama virginiana*) was a frequent part of the hunter's bag during the Lewis and Clark expedition of 1804 to 1806. Mule deer (*Dama hemionus*) shown in figure 5 were less abundant but occurred as far east as Chamberlain, South Dakota (Lewis 1961, Cutright 1969). The Astoria party, which ascended the Missouri in 1811, made no mention of deer while on an overland journey from the mouth of the Cannonball River until they reached the Black Hills of Wyoming (Irving 1868) although they made frequent references to white-tailed deer while traveling along riverways.

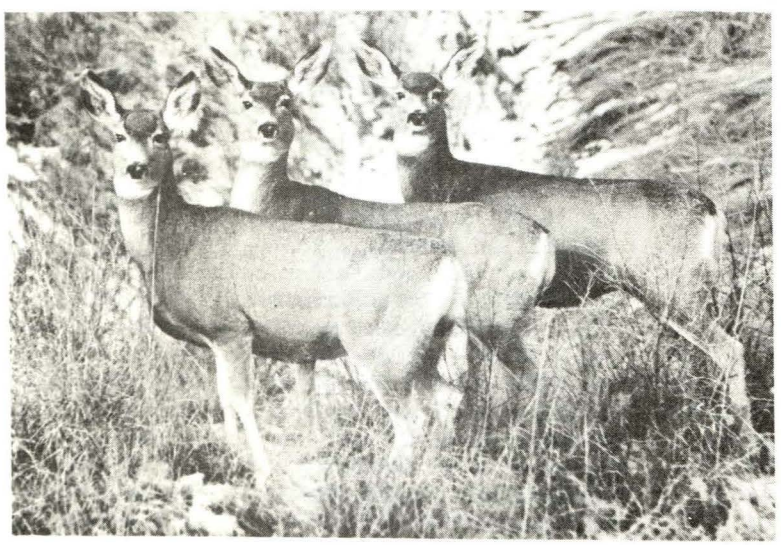

Figure 5.--*Mule deer populations increased on the midcontinent grasslands with the control of hunting and the increase in the abundance of woody plants.*

Bailey (1926) reported mule deer to be plentiful throughout North Dakota until about 1880 when their numbers began to decrease as hunting pressure mounted. By 1888 deer were fairly well exterminated from North Dakota because intensive livestock grazing eliminated the shrubby species that provided excellent browse and cover for deer. In the Great Basin and southwest, however, livestock grazing encouraged the invasion of shrubs (Longhurst 1960); thus, deer habitat was often improved. Mackie (1970), in the northern Great Plains, reported that the food and range-use habits of mule deer and cattle differed substantially. Deer ingested primarily shrubs and forbs, cattle mostly grass. Deer inhabited relatively steep slopes, cattle the more open ridgetops and coulee bottoms.

With the disappearance of the bison and elk, the white-tailed deer became the only large herbivore left on the tall grass prairie and savannah. The forest clearing and patch farming practiced by the immigrating settlers increased the edge habitat preferred by the white-tail and this contributed to a substantial increase in the deer population (Severinghaus and Cheatum 1956). On the northern savannah, however, their numbers declined to less than 2,000 in the face of increasing human populations pressures and year-round hunting. The 1930's depression caused farm abandonments resulting in widespread secondary succession, and the restoration of the habitat (Beckwith 1954). By 1968, deer numbers on the northern savannah had increased to an estimated 845,000 (Nixon 1970).

Bighorn Sheep

Before disturbance by the white man, bighorn sheep (*Ovis canadensis*) were numerous in most mountain ranges of the west, and in the "badlands" along portions of the Missouri, Little Missouri, Yellowstone, North Platte, Arkansas, Colorado, Green, and Gila Rivers, and their principal tributaries. They were never characteristic prairie dwellers as sometimes reported, but they did occupy some of the buttes and badlands of the Great Plains region. They were exterminated early in the history of white man settlement. The last Audubon or badlands bighorn sheep (*O. c. auduboni*) was killed in 1916, near the White River of South Dakota (Hipschman 1959).

Small Game

Increased population size of the eastern cottontail rabbit (*Sylvilagus floridanus*) on the savannah and tall grass prairie coincided with the advent and expansion of agriculture (Lord 1963). Its smaller home range makes it more compatible with intensive agriculture (Beckwith 1954). Many miles of brushy fencerows and grassy road ditches adjacent to cultivated fields have furnished good habitats capable of supporting high cottontail populations. The unspecialized habits of the cottontail make it likely to remain an abundant game animal.

The tree squirrel most commonly occurring in the savannah and along river bottoms is the fox squirrel (*Sciurus niger*). It depends on fruits and nuts but also feeds on crops when these are available. One to three squirrels per acre is considered optimum for this type of habitat (Schwartz and Schwartz 1959).

Two lagomorphs inhabit the extensive upland grassland types. The white-tailed jackrabbit (*Lepus townsendii*) on the northern Great Plains and the black-tailed jackrabbit (*Lepus californicus*) on the southern Great Plains. Both depend on good eyesight and speed to avoid enemies because they are not burrowing animals like many other small mammals. Rather, they rest and hide in shallow depressions, or "forms", at the base of a shrub or clump of grass.

Prairie Dogs

The most conspicuous of the grassland rodents were the prairie dogs (*Cynomys* spp.). Prairie dogs were once incredibly numerous. Because prairie dogs eat grass and compete with the livestock industry, their numbers have been reduced by extensive poisoning programs. Dobie (1949) reported information from writers during the late 1800's of prairie dog towns covering 16 million acres with an estimated 400 million animals. These prairie dog towns provide food and/or cover for prairie rattlesnakes (*Crotalus viridis*), burrowing owls, (*Speotyto cunicularia*), and the black-footed ferret (*Mustela nigripes*). The black-footed ferret is completely dependent upon the prairie dog town for both shelter and food. Man's wholesale destruction of the prairie dog has so reduced ferret populations that this handsome weasel is now one of America's rarest

mammals. Many other wildlife and plant species are associated with the influence of a prairie dog town.

Mammalian Predators

The grassland herbivores originally served as food supplies for a number of mammalian predators. The best known species are the gray wolf (*Canis lupus*), red wolf (*C. rufus*), coyote (*C. latrans*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), mountain lion (*Felis concolor*), and bobcat (*Lynx rufus*). The gray wolf depended primarily on the bison and elk for food. Originally they ranged throughout the United States, but now the only remaining populations are in northern Minnesota, Wisconsin, and Michigan (Mech 1966). Loss of prey species and heavy hunting led to the demise of the gray wolf. It had disappeared from the central United States by 1900 (Schwartz and Schwartz 1959).

The fate of the red wolf, which originally ranged from Illinois and Indiana south through the Ozarks and into Texas, was similar to that of the gray wolf. The current status of its population and its distribution is questionable; however, it is generally conceded that the red wolf is restricted in both categories. Thus, it has been placed on the endangered species list by the United States Department of Interior. In the 1940's Leopold and Hall (1945) reported seeing red wolves in the western Ozarks but Pimlott and Joslin (1968) have since reported that the distribution of this wolf currently is limited to the coastal prairie areas.

The coyote is the only canine predator of any significance remaining on the grassland and savannah. Coyotes are continuously subjected to harsh control programs and heavy hunting pressure, yet coyotes continue to expand their range. The coyote prefers a grass-shrub or grass-tree cover combination and its apparent adaptability enables it to rapidly occupy all such areas created by man.

The red fox and gray fox are found in the tall grass and mixed grass prairies. These two species seem to be adapting to the habitat changes caused by current land use.

Depredations by mountain lion on domestic livestock and the resultant control campaign plus habitat destruction led to the virtual elimination of the mountain lion by 1900 (Schwartz and Schwartz 1959). The bobcat has survived, but its range is much more limited (Schwartz and Schwartz 1959). It has also undergone persecution because of the "all-predators-are-bad" philosophy. This legend seems to rest more on fiction than fact because Korschgen (1957a) determined that the bobcat diet is primarily rabbits and squirrels.

The striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), and raccoon (*Procyon lotor*) have survived in close proximity with settlement; and in some cases they live around homesite buildings. Their food supply consists of small mammals, small birds, reptiles, amphibians, insects, and eggs.

Fish

The important fishes occurring in the grassland streams and lakes are the minnows (*Cyprinidae*), the suckers (*Catostomidae*), the catfishes (*Ictaluridae*), the sunfishes (*Centrarchidae*), and the perches (*Percidae*). Members of the sunfish and perch families have been widely introduced into manmade reservoirs and stock-watering ponds. The best known are the large-mouth bass (*Micropterus salmoides*)[5] and the walleye (*Stizostedion vitreum*) (Schultz 1936, Koster 1957, Bailey and Allum 1962, Cross 1967).

Amphibians

Arid climates pose special problems for amphibians. Grassland amphibians have been able to adapt to the arid climates through the evolution of behavioral or physiological traits that tend to conserve moisture. For example, the tiger salamander (*Ambystoma tigrinum*),[6] plains spadefoot (*Scaphiopus bombifrons*), Rocky Mountain toad (*Bufo woodhousei*), and Great Plains toad (*B. cognatus*) are able to escape drying conditions by burrowing. Rapid development of their young enables the spadefoot to use large temporary rain pools for breeding.

The most widely distributed amphibian in the grassland is the leopard frog

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[5] *Fish nomenclature follows Eddy (1957).*

[6] *Amphibian nomenclature follows Conant (1958).*

(*Rana pipiens*), which occurs in some dry habitat but generally within traveling distance of permanent water sources. The bullfrog (*Rana catesbeiana*) is widespread in the central and lower Great Plains and has been widely introduced elsewhere. The bullfrog is aquatic and must have permanent water sources to survive.

Reptiles

Many of the reptiles (turtles, lizards, and snakes) have adapted to arid conditions. The more common turtles include the common snapping turtle (*Chelydra serpentina*),[7] yellow mud turtle (*Kinosternon flavescens*), painted turtle (*Chrysemys picata*), three-toed box turtle (*Terrapene carolina*), ornate box turtle (*T. ornata*), and spiny soft-shelled turtle (*Trionyx spinifer*). Except for the box turtle, all require permanent sources of water.

Most lizards and snakes don't need free water to live. Species found throughout the grasslands include: earless lizards (*Holbrookia* spp.), horned lizards (*Phrynosoma* spp.), spiny lizards (*Sceloporus* spp.), whiptails (*Cnemidophorus* spp.), skinks (*Eumeces* spp.), collared lizards (*Crotaphytus collaris*), hognose snakes (*Heterodon* spp.), coachwhips (*Masticophis* spp.), racers (*Coluber constrictor*), kingsnakes (*Lampropeltis* spp.), black-headed snakes (*Tantilla* spp.), and rattlesnakes (*Crotalus* spp.). Garter snakes (*Thamnophis* spp.) and water snakes (*Natrix* spp.) are found wherever there are streams or lakes (Stebbins 1954, Conant 1958).

HABITAT MANAGEMENT

Despite widespread vegetational changes, the potential value of much of the original grassland areas as rangeland and wildlife habitat remains very good. Some of the associated wildlife species are now absent; populations of others have been reduced, but the majority of species have adjusted to habitat alterations and remain important components in the modern biotic communities. The oak-bluestem savannah, tall grass prairie, and the western bunchgrass types have been most altered by land use practices. The largest grassland type remaining in America is the nearly 200 million acres of midcontinent short grass-mixed grass type. This area supports a large livestock industry and has a large potential for wildlife protection. Livestock management systems are now in operation on private and public lands that strive for multiple use of the grassland with coordinated livestock and wildlife use.

The large number and diversity of wildlife species plus the variability within the grassland plant communities provides for a large number of wildlife habitat management options. These options are further complicated by year-to-year changes in weather and precipitation. Rangeland wildlife and livestock depend on forage production for food and cover. Forage production can vary from nearly nothing on the high plains during droughts to 9,000 pounds per acre (Curtis 1959) on the tall grass prairie. The discussion that follows relates to the food and cover requirements of many of the species previously mentioned. The land manager must use imagination and foresight to design specific systems to provide for an optimum balance of different habitat components.

Wetlands

Many species of wildlife are associated with the natural wetlands and manmade ponds of the grassland areas. Waterfowl and shorebirds are of primary importance. Grassy shorelines support nearly three times as many breeding pairs of ducks as the bare mud type (Linduska 1964). The composition, density, and height of the shoreline vegetation depends largely on the type of grazing system involved. Season-long grazing systems will deplete the shoreline vegetation even if livestock stocking rates are low, unless there are several ponds or watering areas in each pasture. Shoreline vegetation can be maintained by fencing all or part of a stock dam or by using carefully designed rest-rotation grazing systems. Shorelines that are completely protected from livestock trampling and grazing often contain dense emergent vegetation or shrubs that are not suitable for dabbling duck habitat. Management plans should be designed to produce some mudflats for shore bird feeding areas, grassy shoreline areas for duck nesting, and some emergent vegetation growth for duck brood protective cover.

[7] *Reptile nomenclature follows Stebbins (1954) and Conant (1958).*

Uplands

Brushy cover is to sharptails what grass is to prairie chickens, second growth is to ruffed grouse, and mature coniferous forest is to spruce grouse. On good moisture and soil sites, lack of grazing or rest will bring about an increase in such desirable species as wild plum (*Prunus americana*), chokeberry (*P. virginiana*), silver buffaloberry (*Shepherida argentea*), and hawthorn (*Crataegus* spp.).

Food habits of the sharp-tailed grouse are nearly as variable as the habitats they occupy. Several plant species do occur in most food habits studies, indicating their importance for food and/or cover. These species include dandelion (*Taraxacum officinale*), rose (*Rosa* spp.), hawthorn (*Crataegus* spp.), snowberry (*Symphoricarpos occidentalis*), Russian olive (*Elaeagnus angustifolia*), silver buffaloberry, and buds from *Populus* species. Cultivated crops are eaten when available (Evans 1968). Several of these berry-producing species provide grouse with a winter diet sufficient to survive winter conditions on the northern Great Plains (Hillman and Jackson 1973, Evans and Moen 1975).

Evans and Dietz (1974) tested seven diet materials and found nitrogen-corrected metabolizable energy (Kcal/g. dry matter) to range from 3.91 for corn to 1.39 for rose hips. The fruit of silver buffaloberry was the best native winter food item tested. Fleshy hawthorn berries were ingested in larger quantity than other air-dried foods. For maintenance, winter foods needed to be consumed in large enough quantity to provide metabolizable energy in excess of 1.5 times basal metabolic rate. A key to intensive management of winter habitat for sharp-tailed grouse is the propagation and/or encouragement of high energy-providing plants. Several native shrub species provide good protective cover for sharptails and produce berries that are palatable and high in energy.

Edminster (1954) listed four types of cover required by the bobwhite: grassland, cropland, brushland, and woodland. The grassland provides nesting and feeding cover during spring and summer. Parmalee (1955) found 85 percent of the nests located during his study to be in grassland. Grassland must be open enough to permit birds to move about unhampered (Robinson 1957). Dense grassland cover can be opened by using fire, cultivation, or grazing. Croplands provide crop residue and weed seeds which are valuable bobwhite fall and winter foods. Corn (*Zea mays*), Korean lespedeza (*Lespedeza stipulacea*), and sorghum (*Sorghum vulgare*) are cultivated crops which rank high in the bobwhite diet. Ragweeds (*Ambrosia* spp.), wild beans (*Strophostyles* spp.), *Croton* spp., foxtail grasses (*Setaria* spp.), and sunflowers (*Helianthus* spp.) are native annual plants and are prolific seed producers commonly associated with disturbed areas (Baumgartner *et al.* 1952; Korschgen 1952, 1960; Robinson 1957). Insects associated with cultivated crops and forbs are used for food in spring and summer (Rosene 1969). The brushland and woodland areas are used for escape, roosting, and feeding. Casey (1965) questioned the need for tree cover if brushland was available. Robinson (1957) provided support for this idea when he found the number of coveys in an area to be dependent on the number of "headquarter areas", which were brushy cover dense enough to provide adequate protection during periods of high light intensity. Cover type distribution must be planned and incorporated into a total management plan so that access to all cover types will be available within the home ranges of a covey; a home range varies from 12 to 20 acres.

The cottontail rabbit is a close associate of the bobwhite over much of their ranges. The most preferred foods for cottontail rabbits in Missouri, are bluegrass (*Poa pratenses*), wheat (*Triticum aestivum*), and white clover (*Trifolium repens*) (Korschgen, unpublished data). A wide variety of food species appearing in smaller amounts serve to illustrate the catholic taste of the cottontail. Cottontails may become a nuisance if inclement weather forces them to feed on the bark of shrubs, shade trees, orchards, and windbreaks, thus damaging or killing individual plants. Hunting or trapping can be used to effectively control cottontail populations which are exceeding the carrying capacity of the habitat.

Within the various rangeland habitats from sea level to above timberline, many management practices are available for increasing grazing capacity, improving range condition, and creating new range. All are designed to favor livestock. The non-game bird section of most management plans

are short and generally useless for evaluating effects of different practices on birds and their habitats. The interest and awareness of animals other than cattle and sheep is rapidly growing as managers recognize the value of diversified wildlife populations. Buttery and Shields (1975) have summarized information pertaining to bird habitat values and have pointed out research needs.

Big Game

Mule deer, white-tailed deer, and pronghorn antelope currently offer the best potential for big game management. Deer are browsers and require a supply of woody plants for food and cover. Good sharp-tailed grouse habitat on the northern Great Plains is usually compatible with good deer habitat. Some livestock grazing systems are very compatible with deer and grouse populations. Grazing systems that reduce brushy cover in the small drainage areas probably also reduce deer habitat values.

White-tailed deer range can best be described as a mosaic of croplands or pasturelands and oak-hickory woodlots, brushy fencerows, and wooded stream bottoms (Crawford 1970). A survey of deer food habits in Missouri (Murphy 1970) revealed the importance of cultivated crops in the diet, especially corn and soybeans. This survey showed substantial dependence on shrubs and small trees as a food source. Important shrub species are buckbrush (*Symphoricarpos* spp.), sumac (*Rhus* spp.), and hawthorn. Acorns are an important contribution of the tree component in the more heavily wooded areas. Favorable habitat extends along the major drainage across the Great Plains.

Pronghorn antelope differ considerably from deer in their habitat preferences. Deer prefer woody or brushy areas, and antelope prefer upland and open expansions of grasslands. The forb component of grassland vegetation communities is important to pronghorns.

Predator-Prey Relations

Jackrabbits occasionally become so numerous that control campaigns are launched. Because of their size and differences in food habits, it is estimated that approximately 200 jackrabbits are required to remove range forage sufficient to feed 1 cow (Stoddart and Smith 1955).

The coyote often preys on livestock and big game species; however, Korschgen (1957b) reported that the coyote diet in Missouri consisted mainly of rabbits and rodents. This agrees with Murie (1940) who determined that coyotes in Yellowstone consumed primarily rodents and insects. Consumption of livestock or wild mammals other than those mentioned above was 10 percent or less for each. The evidence indicates that often the coyote could be considered a valuable aide in controlling rabbit and rodent populations. In local instances, coyotes can cause economically significant sheep mortality.

In spite of the fox-chicken legend, it appears that the foxes still depend on wild animals for the major portion of their diet (Korschgen 1957a). Rabbits and rodents comprised more than 50 percent of the diet for both species. Foxes have been considered to have both detrimental and beneficial attributes. Detrimental because they occasionally take domestic poultry but beneficial because of the impact they make on rodent populations and the value of the pelt.

DISCUSSION

Past experience indicates that future habitat management objectives are going to require considerable thought and imagination. The bison, elk, and gray wolf are gone from the grasslands and savannahs--victims of changing land use and indiscrimant shootings. Those game species remaining have been able to adapt to changing land use but even these species are limited in the amount of change that they can tolerate. We have hardly considered the multitude of nongame species present. We know that land use changes influence these species (Warbach 1958, Graber and Graber 1963, Buttery and Shields 1975), but insufficient data makes accurate evaluation of these changes difficult. Wildlife has continually been relegated to areas that are difficult to cultivate or to intensively manage, and these areas continue to dwindle as new economic uses are discovered. There are two broad alternatives available to society. The first is to continue managing with a dwindling habitat base usurped by an expanding urban population and intensification of agriculture practices; or secondly, stimulate incorporation of

habitat management practices in land use planning through education and economic incentives.

The land manager must have some incentive for producing wildlife. It is unreasonable to expect a private land manager to voluntarily donate his most productive land to wildlife habitat when the demands of an urban population for farm and ranch products are so great (Crawford 1970). The practice of charging hunters a fee to use private lands is relatively new in many States, but well established in more populated areas. This economic incentive is becoming increasingly popular (Severson and Gartner 1972). Consumptive users have traditionally shouldered the burden of game management costs through license fees and special taxes on hunting equipment. Very little of this money has gone directly to the landowner as an economic return for the wildlife produced on his land. Future wildlife habitat programs will depend on whether or not man is willing to pay a portion of the wildlife productions costs. Adequate procedures for managing wildlife and methods of application are readily available (Wing 1951, Anderson and Compton 1958, Giles 1969, Allen 1972), but widespread application awaits a basic philsophical change in which wildlife will be recognized as an esthetic necessity rather than an esthetic luxury. The fate of wildlife is inexorably linked with the fate of man.

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